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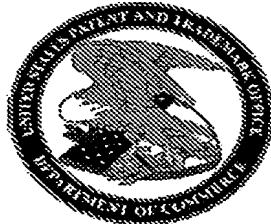
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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<input checked="" type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto		
TITLE OF THE INVENTION (280 characters max) WIRELESS BROADBAND LICENSED NETWORKING SYSTEM FOR LOCAL AND WIDE AREA NETWORKING		
Direct all correspondence to: CORRESPONDENCE ADDRESS		
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ENCLOSED APPLICATION PARTS (check all that apply)		
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<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76		
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)		
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.	FILING FEE AMOUNT (\$)	
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.		
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Respectfully submitted,

Date **10/22/03**

SIGNATURE 

REGISTRATION NO. **42,053**
(if appropriate)

TYPED or PRINTED NAME **Thomas J. Onka**

Docket Number: **5261-105P**

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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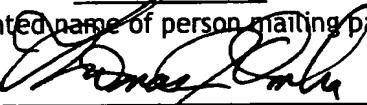
INVENTORS: Marvin Ward, Shant Hovnanian and Chris Vizas.

Type of Documents:

1. Provisional Application For Patent Cover Sheet (x2) - 1 page
2. Check in the amount of \$80.00
3. Specification - 25 pages
4. Drawings - 10 pages
5. Executed Verified Statement Declaring Small Entity - 2 pages
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WIRELESS BROADBAND LICENSED NETWORKING SYSTEM FOR
LOCAL AND WIDE AREA NETWORKING

INVENTORS: Marvin Ward, Chris Vizas and Shant Hovnanian

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FIELD OF THE INVENTION

[0001] The present invention relates to broadband wireless networking systems and more particularly to broadband wireless networking systems using licensed radio spectrum and capable of dynamically monitoring network conditions and dynamically adjusting transmission parameters, including power and transmission type, in substantially real time in order to provide a layered set of network coverage options, from concentrated local area coverage to broadest possible wide area coverage.

10 [0002]

BACKGROUND OF THE INVENTION

15 [0003] The available Radio Frequency (RF) spectrum continues to become increasingly crowded, in part due to the rapidly growing demand for wireless solutions to the "last mile in the loop" distribution problem. This congestion is particularly true of publicly available, or "un-licensed" RF spectrum. The congestion has reached the stage where optical wireless is seriously being considered as a complement to, or replacement 20 for, RF wireless for the crowded point to point and point to multi-point local applications.

[0004] Recent research has shown that even the introduction of equipment with sophisticated compression algorithms in the new bandwidth allocations results in only modest improvements to the congestion. Unlicensed spectrum users located in a number of pockets of coverage, particularly dense urban areas, share modest amounts of 25 bandwidth and have already experienced limited bandwidth availability. Moreover, power in the frequencies allocated for point and point to multi-point RF use often has to be turned down to avoid interfering with adjacent frequencies servicing microwave routes and cells.

[0005] There is a need for a point-to-point and point-to-multi-point RF systems 30 that makes better use of the limited available frequencies, and preferably a system that can operate without interference with adjacent signals.

[0006]

SUMMARY OF THE INVENTION

[0007] The licensed RF spectrum, multi-functional broadband system of this invention overcomes the above-identified disadvantages. It provides a dynamic central-to-remote management system that allows use of multiple numbers of installed smart edge wireless hubs. The system provides dynamic, automated selection of transmission types, including Quadrature Amplitude Modulation (QAM), Quadrature Phase Shift Keying (QPSK) and orthogonal frequency division multiplexing system for broadcast over point-to-point, point-to-multipoint and omni-directional antenna arranged in up to six equal 60° degree arrays. The system of this invention also includes an intelligent data 5 IP packet measurement system that dynamically reads and controls the network Quality of Service [QoS] through software. The automated control may include throttling power up and power down to meet changing effects of transmission parameters in substantially 10 real time.

[0008] In the preferred embodiment, the transmitting antenna system has as many 15 as six orthogonal sectional antenna stages for radiating RF signals. Furthermore, the antenna is capable of automatically applying QAM and QPSK modulation selection to optimize transmission parameters such as path distance, bandwidth and quality of signal [QoS] in point to point and point to multipoint systems.

[0009] In one embodiment of the system, the antenna array combines flat panel 20 and parabolic antenna together to provide QAM, QPSK and orthogonal RF transmission capability.

[0010] In the preferred embodiment, the system also has at least one remote smart edge wireless hub capable of receiving and transmitting three types of transmission format, namely QAM, QPSK and orthogonal frequency modulated signals. The remote 25 smart edge wireless hub antenna system is also capable of adjusting polarizations orthogonally to achieve minimum crosstalk and maximum isolation from lower adjacent frequency interferences, and may also transmit and receives RF signals of different path alignment and carrier frequency types to establish two RF paths.

[0011] Briefly described the invention comprises a wireless broadband 30 networking system that substantially improves Quality of Service (QoS) delivery, makes better use of available frequencies and can be operated at low power. The system is

compatible with use in frequencies licensed by national regulatory bodies such as the Federal Communications Commission (FCC) and is capable of providing user access on a full period basis including anytime user-roaming access with full channel bandwidth availability.

- 5 [0012] In one embodiment of the invention the payload bandwidth is modulated through orthogonal frequency division modulation, allowing frequency reuse. The system also provides improved performance of multi-functional transmission paths by smart access management of user multi-tasked Quadrature Amplitude Modulation (QAM) and Quadrature Phase Shift Keying (QPSK) wireless systems.
- 10 [0013] In the preferred embodiment of the invention, each RF transmitting and receiving stage is coupled to a payload Internet Protocol (IP) switch with the ability to route IP traffic under management of a micro controller. The micro controller associated with the core microwave radio contains the lookup file database and uses it to maintain strict control of the network, the IP payload data and the smart edge wireless hubs. The 15 system has both orthogonal and QAM / QPSK modulated transmission interfacing antenna arrays in an arrangement that radiates and receives radio frequency signals in direct point-to-point line of sight pattern and orthogonal frequency division modulation that radiates over an omni directional 60° degrees RF patterns in sectors of up to 360° degrees maximum radiation pattern and using three modulation encoding algorithms for 20 point to point transmission and orthogonal frequency division modulation providing frequency reuse with power and orthogonal polarization controls. The system provides for a variety of one-way and two-way communications services, including Wi-Fi, private and public channels and digital two-way transmission internet channel with IP (TCP/IP), video and data, as well as voice using internet protocol (VoIP) packets employing 25 special dynamic, roaming and emergency or public services channels and IP bandwidth user accessed channels. A dynamic bandwidth controlled channel coupled with fixed and hot variable assigned bandwidth in the 27.5 to 29.5 GHZ millimeter wave band region is employed along with very fast payload switch routing channels over a series of available dynamic microwave channels is engaged and controlled through automated quality of 30 service QoS monitoring and selection circuitry. The system has the ability to transmit and retransmit and receive and verify highest of quality of service QoS to dynamically

select the best improved path through the bursting of RF coded signal and measuring and compensating the polarization selection circuit method and changing type of encoding algorithm to achieve the preset QoS requirements. Further dynamic route selections is achieved using fast packet switching diversity coupled with providing route diversity,

5 frequency diversity, encoding algorithm diversity and space diversity and radio frequency polarization diversity. The systems user roaming channel is always on hot and ready to respond by accepting an user request for broadband service in as simplistic form as a user jumps on at will and off at will controlled through a pre-registered access user code lookup file that automatically addresses the user upon their first entry when logging onto

10 the system at any data grid network.

[0014] The smart edge hub controller allows users to request and dynamically change a destination address and bandwidth requirements at user need in a virtually real time channel spread over a series of prearranged Data Grid Gateways™. The Data Grid Gateway™ setup provides bandwidth and destination information of the user who requests to communicate locally through the Data Grid Gateway. The user can enter or exit at will; all dimensions of any Data Grid Gateway at will through the hot on channel feature of the switching controller and may send a higher data rate level request to the interface controller of the radio modulator and demodulator. The data packet destination cell carries, at all times, an authorization key code that is pre-assigned and opens an available RF channel embedded in assigned radio bandwidth and transmission frequencies positioned on an opposite polarization channel with signal being transmitted from the originating smart edge hub site and location of the user.

15

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[0015] It is important to understand that the basic system component, the smart edge wireless hub, operates on several levels but has three critical functional roles which can be carried on by the smart edge hub simultaneously or separately:

25

[0016] 1. the smart edge hub provides a concentrated local area RF network coverage for a single user (or related set of users), using technical power and spectrum management techniques as well as the legal protections of the licensed RF spectrum to assure against interference and congestion;

30 [0017] 2. the smart edge hub provides a channel available for use by higher network levels (and under control of the core microwave radio or other network elements

above it in the hierarchy of a particular network configuration) for routing and connectivity for smart edge hubs other than the one providing the channel; and,

[0018] 3. the smart edge hub acts as a gateway for connectivity to higher levels of any network configuration, providing both RF connectivity and wireline connectivity.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 shows an illustration of the core microwave radio transmitting and receiving links to smart edge hubs according to the preferred embodiment of the invention making up one data grid. FIG. 2 is an illustration of a first embodiment of the invention, showing six transmit and six receive RF paths representing transmitted signals sent out and received input from smart edge wireless hub sites of six antenna sectors making up one cluster of six antenna arrays.

[0020] FIG. 3 is an illustration of RF ring architecture, showing the core microwave radio RF path and smart edge wireless hubs on one of two available polarizations and RF paths.

[0021] FIG. 4 is a top plane view illustrating two clusters of core microwave radios internetworking horizontal and vertical polarizations and applying different encoding signals necessary to reach distant sites demonstrating QoS requirements.

[0022] FIG. 5 illustrates four frequencies in six-sector frequency reuse used in orthogonal frequency division multiplexing.

[0023] FIG. 6 shows an illustration of one data grid gateway with four smart edge wireless hubs demonstrating applied polarization configuration for frequency reuse in one cluster of four smart edge wireless hubs.

[0024] FIG. 7 diagram of core microwave connectivity for setting up roaming channels, emergency public channels routing between smart edge hubs and routing through a matrix over RF paths forming dual channel seamless paths.

[0025] FIG. 8 illustrates block diagram of one core microwave radio that provides three encoding frequencies selected to adjust bandwidth, RF operating range, and roaming function through IP switch.

[0026] FIG. 9 illustrates block diagram of one core microwave radio with four frequencies in six sectors for implementing orthogonal frequency division modulation with signal management and flow configured as illustrated in FIG. 8.

[0027] FIG. 10 illustrates block diagram of one smart edge wireless hub with 5 typical LAN and IP data connectivity to peripheral networking equipment and interconnecting at radio frequency to and from pro-band core microwave radio and controller

DETAILED DESCRIPTION

[0028]

10 [0029] During the course of this description like numbers will be used to identify like elements according to the different figures, which illustrate the invention.

[0030] To understand the invention it is easiest to focus first on the smart edge hub and next on the core step upward in network hierarchy – an individual data grid. (The individual data grid consists of a core microwave radio and system core micro controller, an IP switch combined with a number of smart edge wireless hubs, as 15 illustrated in FIG. 1). From these basic elements, one can then trace additional elements of network structure, working through the orthogonal frequency division modulator and demodulator to the six antenna and out over the transmit and receive paths of each element linking an RF signal to one or more remote smart edge wireless hubs. A 20 complete data grid network is formed from one core microwave radio, one associated core micro controller, an IP switch, six orthogonal antennas, an optional QAM/ QPSK modulator and demodulator networked into one antenna employing RF transmission and reception to connect smart edge wireless hubs that have operational and RF connectivity to the specific defined core microwave radio and controller.

25 [0031] As seen in Figures 1, 2 and 10. a smart edge wireless hub can operate alone, providing a local area network for a single user (or an identified group of users). Or a smart edge hub can operate with one or more other smart edge hubs and/or a core microwave radio, providing connectivity between two hubs to create a single, extended 30 local area network. Or a smart edge wireless hub can provide connectivity between itself and other users on or off the network through higher network levels, or it can provide a “bridge” of one or more channels for connectivity among other users and other smart

edge hubs. At its simplest level, a network can be a single smart edge hub subject to supervision by a core microwave radio and associated micro controller.

[0032] The smart edge hub provides residences or businesses with the equivalent of a private network using licensed spectrum that can be employed within the residence or business. In effect, it provides a wireless broadband Local Area Network (LAN) which, if desired, can be coupled with a wired network. One of the advantages of such a wireless LAN is that it can span significant geographical areas if necessary, such as reaching across town, simply by deploying two or more basic hubs. The user of the smart edge hub is assured security, exclusivity and Quality of Service, including avoidance of interference and congestion, by the spectrum licensee, whose licensed spectrum is being used by the residence or business. For instance, in the USA, the appropriate spectrum is licensed from the Federal Communications Commission (FCC). The system then achieves the aforementioned advantages by the national or international regulatory body, in this instance the FCC, licensee authorizing the customer to use its basic hub within a certain geographic area. The area of use may be registered at the time of acquisition of the smart edge hub and may be changed by re-registration. The regulatory body licensee may be responsible for policing the use of the licensed spectrum within the area of use, assuring against other parties using or misusing the licensed spectrum. As part of one method of policing the spectrum use, the regulatory body licensee may retain, for the basic hub, the authority and the ability to reallocate or adjust bandwidth, to adjust power, to adjust or change modulation schemes for some or all channels and to otherwise monitor and effect the performance of the basic hub. This control may be exercised through a core microwave radio, or other controlling device. The control may be up to and include the ability to shut down the smart edge hub if it is creating improper interference, has been modified in any way or in an emergency situation. In such a model, the spectrum licensee is effectively taking a new step in radio communications by allowing the user to own and operate the facilities at the lowest level of the network. This ownership and operation, however, would be implemented with technological and legal means for ensuring compliance with the appropriate regulations and operating requirements established by the licensee in accord with the licensing authority.

[0033] The higher level network building blocks of the core microwave radio and the individual data grid would ordinarily be under the direct control of the regulatory authority licensee. It could, however, be provided to certain customers with the same sorts of technical and legal controls and constraints as those outlined above for the smart edge hub, and upon the same operating rationale, including protection of the spectrum from interference.

[0034] As seen in FIG. 2 there can be any number of smart edge wireless hubs in each individual data grid network, depending upon the pre-login records held in file within the local core micro controller, and these may number into the hundreds connected through vertical and horizontal polarization with QPSK/QAM modulation or orthogonal polarization with radio frequency orthogonal modulations of RF channels directed by the core microwave radio and managed by a core micro controller and multiples of remote smart edge wireless hubs. This entire embodiment forms one entire data grid network element and for shorter descriptive purposes, is referred herein as a single cluster site.

10 Smart edge wireless hubs may be positioned physically anywhere within the cluster if within RF distance operating range. Operating range is considered satisfactorily if within the cluster site RF operating range with either modulation type applied, QoS standards can be met. The smart edge wireless hub communicates via RF transmission up stream and down stream through one QPSK/QAM or up to four primary orthogonal radio frequency paths established per sector or directly to a single hub can be over an RF channel operating as vertical-horizontal or orthogonal polarizations. FIG. 1 Illustrates only a single RF channel directed to smart edge wireless hub channel, any of two can communicate among each other by transmitting, and receiving RF signals homed to and from the core microwave radio under remote control of the core micro controller.

15 Description and operation of multiple RF channel links to smart edge wireless hubs will be discussed under FIG. 2 and FIG. 3.

[0035] Now turning to FIG. 2 any one of the smart edge wireless hubs configured as slave mode option, a single micro-controller is slaved by way of RF transmission path to a core microwave radio core micro controller. Each smart edge wireless hub is provided a remote controller that can operate in two modes namely; slave option - distributed architecture mode for operating in conjunction with the core microwave radio

and core controller. Referring to FIG. 3, it can be seen that the smart edge wireless hubs in sites D and site C, operate with option two and function as master/slave. These two smart edge wireless hubs are situated so as to form a sub-cluster, as illustrated in FIG. 3.

[0036] A block diagram schematic of the preferred embodiment of the transmitters and receivers is illustrated in FIG. 4. Four transmitters are at the omni directional radiating node of a group of cells arranged in a geographical array. Illustrated in FIG. 4. A digital four channel multiplexer housed as a part of the core microwave radio frequency reuse plan, provides up to four transmit and four receive frequency stages having digital modulation and are connected to the omni antenna array where each radiate RF signals towards multiples of smart edge wireless hubs situated in various positions within the six sectors of the omni antenna array path. Each of the antenna arrays are fed orthogonal frequency modulated signals with digital modulated content sent over each one of the antenna arrays in the maximum of six radiating sectors.

[0037] The signals arrive at the receiving smart edge wireless hub antenna and depending upon the modulation scheme selected, each signal can be selected remotely by the core microwave radio core microcontroller, depending upon the quality of signal QoS received in both directions of transmission. Typical performance includes the two operating modulation schemes depending upon distance between the smart edge wireless hub and core microwave radio, is selectable by the core microcontroller.

[0038] An understanding of the details of the smart edge wireless hub and the omni directional transmitters at the core microwave radio is important as is the importance of understanding the orthogonal frequency modulated system. Refer to FIG. 6 the forgoing technique permits a wide variety of ways to improve quality of signal performance. When a smart edge wireless hub is placed in service a relative short distance from the core microwave radio, the signal QAM/QPSK modulation type is selected for maximum possible payload transfer (bandwidth) although it may operate a less distance. Another smart edge wireless hub located a longer distance away would operate using yet another modulation type, adding extended range. Refer to FIG. 6, the transmitting antenna array provides a four cluster polarization arrangement for radiating RF signals with digital coded data sent out upon initial turn up for testing the RF path under program control of the core microcontroller in the core microwave radio. This

polarization arrangement allows the reuse of frequencies in adjacent channels within the same cluster. The received RF coded signal is analyzed in one direction only; transmission of RF signal from the core microwave radio, using all four RF signal types are tested and logged in memory for future QoS comparison and reference. Specific
5 operating parameters can impinge on the RF signal; degraded weather can change an RF signal quality and reference causing even another modulation format to be selected. Path analysis is performed during initial turn-up and through automatic selection of different reduced power; settings with modulation types and polarization choices can take place in milliseconds of time without loss of signal in the system. Transmitted RF signals
10 received from more than one source may undergo RF signal variances in quality due to weather or varying distances from the core microwave radio however, any intrinsic differentiation between each frequency is quite wide and unintentional reception will not take place. The core micro controller illustrated in FIG. 3 slaves the smart edge wireless hub controller at sites C and D to prevent mismatch of transmit frequency choices from
15 taking place between the two locations and controls the frequencies and power settings for the path between site C and site D even that these are remote links isolated by RF path from the core microwave controller.

[0039] RF signals arriving at site D receiver enter into the smart edge wireless hub reaching a receiver detector where composite signal detection takes place and IP
20 payload content is decoded in the form of IP packet data. After extraction, these packets are aligned according to IP address code carried in the header located within the data formatted packet. Data directed over routes linking sites C, D back to the core microwave radio are switched automatically per reference to QoS, actual load on each radio path and available bandwidth availability. A specific RF signal path and signal
25 route taken to reach the smart edge wireless hub end user is irrelevant to data packets delivered. The incoming signal and resultant retrieved packets all arrive within milliseconds of each other and delay is considered negligible. The QPSK / QAM transmit RF frequencies transmitted to a smart edge wireless hub are never greater than two, one applied to horizontal and a second to vertical polarizations. During the initial
30 RF path setup and testing sequence, the controller will exercise tests of all frequencies and transmission types and log the results in database.

- [0040] Now turning to FIG. 1 and FIG. 9, the core radio and omni antenna provides a second optional RF path sending and receiving payload signals to equipped smart edge wireless hubs positioned remotely to any one of up to six antenna sectors providing coverage to wide area locations and each antenna sector covers a physical space area of 60⁰ degrees maximum per antenna array and six omni antenna arrays illustrated in FIG. 3, would cover an area of 360⁰ degree radius, sending RF signal outward, to a range of about one to eight miles, depending upon transmit power settings, type of system transmit signal encoding format applied, physical terrain makeup and variable weather conditions within an area. Refer to FIG. 7, the second RF path transmitted that links each site provides additional bandwidth expansion setting up an alternate channel for special subscriber services that include; hot on channel for subscriber easy access to roaming, emergency community communications and dynamic bandwidth expansion of the primary channel bandwidth beyond the normal payload sized network provided in similar systems.
- 5 [0041] A primary RF channel transports normal payload IP data traffic while operating on horizontal polarization with separate assigned frequencies, and while the secondary RF channel operates on vertical polarization being assigned a different frequency; both channels are controlled through the micro controller and payload IP switch located at the core microwave radiolocation. This extended bandwidth is separated into individual payload nodes, providing part time and full time access for services. This mode of operation is unfounded in normal radio base band. The core microwave radio operating with virtually any number of smart edge wireless hubs provides several unique and separate expansions and use of microwave radio bandwidth to accommodate subscribers as listed in the following table:
- 10
- 20

Primary RF Path			
Subscriber Use	Channel	Path #	Payload
IP Traffic	Channel A	Path #1	IP Data

Secondary RF Path			
Subscriber Use	Channel	Path #	Payload
IP Traffic	Channel A	Path #1	IP Data
Roaming Hot On	Channel B	Path #2	IP Data

Emergency Community	Channel B	Path #2	IP Data
Dynamic Load Control	Channel B	Path #2	IP Data

[0042] Illustrated in FIG. 7, the above primary and secondary RF channels provide an advantaged method of expanding the systems bandwidth without adding expensive external peripheral equipment for bandwidth control and multiplexing. This invention provides an extended bandwidth and service offering to the network user who simply and quickly jumps – on, and jumps – off, the smart edge wireless hub at any given site and any time and at will greatly simplifies the typical PC user's efforts to link up and tear down a network connection. In FIG. 4, the subscriber user can disconnect or disengage from the data grid area site D and smart edge wireless hub and travel to a second and different data grid site A., and simply and quickly connect at this different smart edge wireless hub site and start the communicating as if the device never left the first site D network. This seamless transfer can take place only through shared central data bank storage of subscriber information whereby data can be flagged for hold status as the subscriber disengages at the first location and readdressed the information at the original site placed in hold status and later reappeared at a different data grid network. The smart edge wireless hub software program sends bursting data up-stream to share status information with other microcontrollers and payload IP switch on a continuous basis during all subscriber sessions, including sign-on, sign-off, stop sending and hold/transfer status. The actual software code and data instructions are defined under separate patent references.

[0043] Again, referencing FIG. 4 and FIG. 7 the inherent pathways are defined for broad bandwidth capability of this system herein and programming will be done under separate reference. Now turning to bandwidth expansion using a secondary channel, this function is achieved with the present invention more economically and essentially with the same antenna systems that support a second RF channel very easily and with limited new expense. This provides a significant cost reduction and reduction of hardware and software required. Now again turning to FIG. 4 specifically to smart edge wireless hub designated sites B, D are both linked back to the core microwave radio site 001A. Sites B and D are equipped with a second transmitter/receiver system

numbering the total of two antennas that sets up a second antenna path between Site D and Site B in such configuration as to form a triangle RF transmission path between the three sites identified. Each sectional single path of the three paths forming this RF ring operates dual RF paths having vertical and horizontal polarizations applied. Each RF

5 path carries IP packet payloads in the form of primary A RF channel and secondary B channel with B channel content illustrated in FIG. 7, carrying roaming hot on line traffic, emergency community traffic and the dynamic load control channel and in addition, this RF triangle arrangement provides security surveillance and IP data for real time video cameras, security door locks and a high level of secured path for activated security coded

10 keys. The triangle RF system transports cipher protected packets of highly classified data and each of these cipher protected packets scrambled in session to form a dual path of data where a data word is sliced and assigned into digital coded words in IP formats and again separated into two data RF path flows, one transmitted on path B and path D to reach site B and the second transmitted from the core microwave radio is directed to site

15 D by path B. Note that two path hops are required in one leg while only one RF path or hop is required to complete the path from core microwave radiolocation to site D. The invention of this routing provides digital data transported over paths B to D will arrive at site B ahead by a few milliseconds of data that passes through site D and repeated on to site B requiring two RF hops. The data first arriving at site B carries an assembly and de-

20 assembly code for assembling and taking apart data bits arriving on the delayed channel. The transmitted key is therefore sent the shortest route and a different route than the data packet carrying the actual payload. The supervisory code is never transmitted over the same path with data content that it is to control.

[0044] Cipher-lopes are electronic secured packets of data that are highly secured

25 through packet-coded keys, assembled in highly secured sealed electronic digital packets of IP data that are coded close, and sent over the above link to highly secure the data content. Should the packed ever be opened during transit, a flip-flop logic circuit will leave a tell-tall sign of the intrusion and breech of security. The RF path is constructed in physical form to provide full path and system diversity through a fully physical and

30 licensed radio RF link separation. The two data paths reach their secured environment only in an proper protected environment where the two keys match a series of ever

changing digital coded word in the form of management instructions and only after being fully exercised and tested with these digital words are these words allowed to be used to de-cipher and assemble the packets of data at the receiving station, demanding duly authorized code to open and detect the content.

- 5 [0045] Turning once again to FIG. 7 the architecture of a single cluster illustrated in FIG. 2 defines the method used to establish a primary channel and secondary channel covered above. The cluster illustrated and referenced as FIG. 7 has four smart edge wireless hubs representative of circles that are encircled around a center cell representing the core microwave radio, the microcontroller, and payload switch. One cluster when
10 attached by RF to other clusters provides internetworking connectivity and control to multiples of smart edge wireless hubs illustrated in the FIG. 4. Referencing FIG. 7 and drawing attention to the connecting outside illustrated lines encircling all four smart edge wireless hubs, these represent the primary channel, and a second inside line paralleling the outside lines is the secondary channel. Note that in the FIG. 7 and FIG. 4 discussed,
15 all four smart edge wireless hubs are interconnected and communicate to each other by means of establishing the RF path between each multiples of smart edge wireless hub back to the core microwave radio sites 001A and 002A both being located at the core center of the cluster. Note the multiple RF paths are optional for establishing and maintaining a well-secured and seamless infrastructure that is able to support the highest
20 of transmission protection for securing cipher-lopes. Banks and other corporations needing to send secured documents are an example of the need and use of cipher-lopes. The entire system is structured around each smart edge wireless hub having a direct RF path and seamless RF signal path in multi-flow form producing a very high level of security that enables both A and B channels to transmit their content over a private
25 licensed frequency microwave channels provides a very secured path to the cluster core micro controller and payload IP switch. In this configuration, the cipher-lopes data packet does not have to flow back to the core microwave radio site, it can be managed by each slaved processor located out in the best location where it can remain operating in a distributed RF channel controlled and managed remote network by the local
30 microprocessor in smart edge wireless hubs. The remote microprocessor is always slaved to the core microwave radio site, microcontroller, and payload IP switch. Content of the

secondary RF channel carries signals destined with roaming hot on, emergency community channel, and a dynamic load control channel in addition to transporting the Cipher-lopes secured content.

- [0046] Links from the core microwave radio-connecting cluster of FIG. 3, and 5 FIG. 7 to other outside clusters are illustrated by the two lines connecting by way of radio path having both horizontal and vertical polarizations. These RF paths are direct point-to-point radio channels and sends RF signals on both vertical and horizontal polarizations.

[0047] Drawing configurations FIG. 3 and FIG. 7 illustrates the invention and 10 system path configuration that supports transmission of cipher-lope in the form of secured data between multiples of smart edge wireless hubs located in and outside the cluster that is uniquely capable of forming a protective microwave ring for RF transmission protection and in case one path is lost due to transmission failure. The general rule is never send content and setup / takedown instructions in the same IP packet 15 and never over the same RF paths. Routing of the Cipher-lope packets is controlled by core IP switches and micro controller. In routes where the Cipher-lope destination may take it across seamless boundaries from one cluster site to another clustersite as illustrated in FIG. 4., then setup and take down procedures are passed from the originating cluster to the second cluster core micro controller.

- [0048] This security level can be utilized for IP security of any sort, outside 20 Cipher-lopes applications. Voice over IP (VoIP) and video digitized content can be provided a higher level of security on the licensed radio band. An understanding of the details of FIG. 8 and FIG. 9 diagrams and the different method of achieving modulation and the advantages of one type modulation selection over the other are important. There 25 are three choices of selecting modulation types, namely orthogonal frequency division modulation, QAM modulation and QPSK type modulation. All three-modulation types have some advantages and trade offs. The advantage of orthogonal frequency division modulation or OFDM is that it allows the reuse of RF frequencies in terms of efficiently expanding the overall size of the network when limited amount of licensed frequencies 30 are available. As discussed earlier and referenced in FIG. 6, setting polarizations and using much improved antennas and throttling transmit power down to an accepted QoS

level can enhance the overall performance of the network. OFDM is a multi-carrier modulation scheme and is used in the RF and infrared channel very efficiently. Turning to FIG. 8, the difference in the QAM and QPSK modulation schemes, both are conventional single carrier systems with data symbols that are collected in predetermined levels such as four, eight, sixteen and up to sixty-four level encoding or modulation levels. Bandwidth suffers at the lower encoding rates and sending data symbols in parallel can increase bandwidth. Normally the conventional single carrier system sends data symbols sequentially. In higher data-rate communications the symbol periods becomes smaller than the delay spread of the channel and inter symbol interference occurs. In multi-carrier systems, a number of data symbols are transmitted at different sub-carriers in parallel, thus increasing the symbol length. This scheme provides more bandwidth however, the distance the RF signal can reach out or travel for a set amount of power is reduced. There are cases where distance is more important than bandwidth, and the system allows for this option.

15 [0049] Now turning to FIG. 9 more importantly, the RF microwave transmission system adapts orthogonal frequency division modulation at all smart edge wireless hubs broadcasting RF to achieve frequency reuse efficiency and to provide improved RF reception performance and local loop reliability. OFDM signals are transmitted in an omni pattern of up to 360⁰ degrees geographical coverage at A, B, C D, and E sites illustrated in FIG. 3 and 4. Coexistence with the point-to-point microwave system is accomplished by limiting multipath interferences, using cross-polarization components, and separating adjacent channel interferences by applying frequency band reuse techniques. This is accomplished with use of highly directional antennas and giving serious consideration to physical placements of antennas and using antennas with low side lobes for each direction of transmission and finely, applying robust modulation techniques with errorcorrection techniques. Antennas applied need to have high rejection performance of cross-polarizations standards. To reduce co-channel interference, the system measures transmitted power of each leg by taking measurement samples of each RF receiver level sensitivity and bursting each of these results in the form of packet overhead back to the transmitter end allowing the microcontroller to take action and throttle the transmit power to a level that results in reliable and useable transmission

signal quality and is further automatically measured against system preset QoS level standards. Frequency reuse is employed in each smart edge wireless hub to expand the capacity of each core microwave cluster. Again referencing FIG. 4 each of the four smart edge wireless hubs use frequency reuse techniques applied to expand coverage 5 capacity of each cluster site. Within each smart edge wireless hub coverage area, seamless reuse of full frequency band spectrum will be accomplished many times as the system grows in number of clusters that can be networked together. FIG. 5 illustrates a four frequency six sector frequency re-use pattern is applied to modulate and transmit the payload signal applied to each six sectors and antenna arrays that cover an geographical 10 area up to 360⁰ degrees diameter further illustrated in FIG. 1.

[0050] Turning to FIG. 4 within a cluster, polarization of each sites A, B, C, and D are setup as defined to minimize adjacent transmit frequency interference. The full frequency band is reused for maximum frequency spectrum coverage in each smart edge wireless hub site. The microcontroller detects any RF link loss and will reverse direction 15 so that information flow in these protected links is un-interrupted smart edge wireless hubs A, B, C, and D form an outside transmission ring that operates seamless as illustrated in FIG. 4. and within the inside RF ring from center of the rings, the core microwave radio is equipped with a transmission path to transmit over four paths, namely the A1 path to B1 path and C1 path to D1 path, out to each respective outlying smart 20 edge Wireless Hub, A Hub, B Hub, C Hub and D Hub.

[0051] Now turning to FIG. 8 and FIG. 9, the two diagrams share much common signal processing until the final modulation stage is discussed. It will therefore, be important to understand the difference of the two modulation processes and these will be explained separately once at that stage. Beginning with both FIG. 8 and FIG. 9, the user 25 interface is representative at 20 input to a 10/100 base T copper or SX fiber interface to the transmit input. Note that at 20 the receiver above, the receive signals is output to the end user on a LAN and the input from LAN is at the transmit side of the circuit.

[0052] For the transmit direction note that the IP 28 Ethernet signal passes through the transmit interface to a stage called; IP data switch 5 where the packets 30 address headers are detected and read and the IP packet signal routed either to three choices, to the roaming IP switch if the header code signifies that the packed address is a

roaming channel Note, as discussed earlier, the patent application will not address the software code of the IP packet header control nor will it discuss the software of the IP switch 5 and microcontroller. What will be presented is the unique originality of the common channel aligned throughout each and ever site to originate a seamless hot on

5 roaming channel, and emergency community channel and dynamic load control channel that operates in each and every outlying smart edge wireless hub. Securities of these channels are set up according to the cipher-lope standard of operation, rendering all site bandwidth to be highly secured for both the primary and secondary channels.

[0053] All categories of packets passing through the IP switch 5 will output in
10 three paths to the IP bandwidth channelizer where each packet is placed into a batch assembler according to destination and purpose. The two special packets are placed given secondary path coded destinations called red code and the local data representing user input broadband data is placed in the primary coded batch stage will be designated red code. From the IP channelizer, data in the form of blue and red code passes into a
15 multiplex 30 stage where the processor 5 controls type of modulation to be implemented, resulting in QPSK, QAM or orthogonal type transmission. This level of operation is set up by software for system type, control, and monitoring. The adaptive modulator and algorithm determines the level of encoding that takes place to each primary and secondary payload. Passing through the channel emulation and adaptive bit control, the
20 signal arrives to one of three levels of encoding 1 for example, the QAM has three standard encoding formats 1, 4 level, 8 level and 16 level QAM encoding as shown in FIG. 8 and for the orthogonal type modulation, refer to FIG. 9, the signal arrives at 3 the orthogonal frequency division transmit / receive stage where the FIG. 5 four 24 frequency – six sector 6, 7, 8, 9, 22 reuse is implemented.

25 [0054] These signals are transmitted out into each of six sectors 10, 11, 12, 13, 21, 23 illustrated in FIG. 1 and received by the same sector antenna array. The six signals are received by an orthogonal antenna 15 at the smart edge wireless hub 18 and are interfaced 16, 17 into the smart edge wireless hub 18 controlled by the remote micro controller 19 at the remote site. FIG. 1 illustrates the QPSK and QAM transmission path
30 14 between the antenna 15 at the smart edge wireless hub and the antenna 2 at the core microwave radio receiver input and transmits 1.

[0055] Now referencing FIG. 8 and the transmitted signal arriving from a remote smart edge wireless hub arrives either in the orthogonal six antennas 6, 7, 8, 9 and 22 or if QPSK or QAM, modulation, the signal will be received by antenna 2 in the receive input direction of the core microwave radio 1, 3, 4, 5 that represents all the stages 5 including the micro controller and IP switch. In FIG 8 and FIG 9, the receive RF signal(s) 1, 2, QAM/QPSK and 6, 7, 8, 9 and 22 interface the one or two of the single antennas and for the orthogonal modulated signal, the RF interfaces the input orthogonal antenna to bring one or more signal formats into the receiver circuit 1, 3, of the channel estimation and adaptive bit control circuitry. From this stage of the receiver, serial packet 10 data moved to the adaptive demodulator and to the de-mux 29 where the packet signal is converted to form of IP packet data and received input to the IP bandwidth channelizer receive grid and separated into three types of data, namely, roaming data, 28 local bandwidth data and emergency data that is fed into the IP data switch, 30 local IP data switch and roaming switch 5 where the IP packet is stripped of destination header and IP 15 data directed into the Ethernet Packet format interface for conversion to 10/100 BaseT or SX optical fiber transmission interface for user purpose, 20. The system explanation is of high level, however software management for setup, testing, and integration into a working circuit at the end user would be provided under a separate software filing.

[0056] The embodiments of the invention described above provide a licensed 20 microwave radio multi-functional broadband system that includes dynamic central to remote slaved management system having multiple numbers of installed smart edge wireless hubs. The system is capable of selective transmission type QAM, QPSK and orthogonal frequency division multiplexing system for broadcast over point-to-point, point to multipoint and omni-directional antenna arranged in six equal 60⁰ degree arrays.

25 [0057] There is also an intelligent data IP packet measurement system through software dynamically reads and controls Quality of Service [QoS] and throttles power up and power down to meet changing effects of transmission parameters in virtual real time.

[0058] The system has receiving remote antennas capable of changing polarization settings to allow frequency reuse, and with programmable receive low noise 30 block (LNB) filters to minimize adjacent RF signal cross talk.

[0059] The system's antenna system has a six orthogonal sectional antenna stage for radiating RF signals and an antenna that applies QAM and QPSK modulation selection automatically to achieve path distance, bandwidth, quality of signal [QoS] in point to point and point to multipoint systems.

5 [0060] In one embodiment of the system, the antenna array combines flat panel and parabolic makeup together to serve QAM, QPSK and orthogonal RF transmission.

[0061] In another embodiment of the system the transmitting antenna system includes a remote smart edge wireless hub capable of receiving and transmitting three type formats,QAM, QPSK and orthogonal frequency modulated signals in the same 10 mechanical antenna, receive, and transmit final interface structure.

[0062] In one embodiment of the system, a remote smart edge wireless hub antenna system adjusts polarizations orthogonally to achieve minimum crosstalk and maximum isolation to lower adjacent frequency interferences.

15 [0063] In one embodiment of the system a remote smart edge wireless hub antenna system that transmits and receives RF signals of different path alignment and carrier frequency types to establish two RF paths.

20 [0064] In one embodiment of the transmitting and receiving system there is a primary RF channel linking local and remote smart end wireless hubs primary RF channel A for IP data traffic and a secondary RF channel linking local and remote smart end wireless hubs secondary RF channel B for user roaming hot on. There may also be a secondary RF channel linking local and remote smart end wireless hubs secondary RF channel B for emergency community channel service and a secondary RF channel linking local and remote smart end wireless hubs secondary RF channel B for dynamic load control for user IP data.

25 [0065] In one embodiment of the invention, there is also a dynamic RF re-routing in ring configuration system that includes a network RF path direction that can be redirected upon failure of the primary RF path or secondary RF path on a seamless basis.

[0066] In one embodiment of the invention there is a network RF path sending 30 data over a RF network with data content divided into two or more paths to support cipher-lope highly secured content by sending setup/takedown code in direct path and content in second and longer path.

[0067] One embodiment of the invention includes a physical encapsulated packet that contains a header referenced to activate an onboard physical circuit flip/flop control to indicate packet-tampering status.

5 [0068] A further embodiment of the invention includes a secured encapsulated packet management system that reads status at a physical point along the transmission path in virtual real time and with electrical / physical tells circuit status.

10 [0069] In another embodiment of the system the core microwave, microcontroller, and IP switch includes a user time-share of bandwidth on a part time basis on 7 x 24 x 365 time having access at any smart edge wireless hub location. There is also provision for a user, or multiple users, to have time-share access to emergency channel use in case of local emergency or local and national disasters that communications channel are linked to federal state or local government authorities for local use and purpose.

15 [0070] In a further embodiment of the system the core micro controller and IP switch includes a bursting data stream up-link and down link from the smart edge wireless hub to and from the core micro controller and IP switch to measure QoS and make system equipment adjustments to outlying equipment power, polarization, switching modulation types for management of core network.

20 [0071] There may also be a system setup for establishing a data grid around the core microwave and multiples smart edge wireless hubs that provide exclusive and non-exclusive security services in the form of security surveillance cameras, door/window alarms or other entrance locks and including proximity alarms, remote alarms, temperature controls, fire and water alarms that report to distributed or centrally located points.

25 [0072] In one embodiment the core micro controller and IP switch and smart edge wireless hub controller includes an enhanced forward error correction coded algorithm signal monitors IP data performance for errors, dropped packets, noise on transport facilities and system processors adjusts of corrections or transfer payload on pre-selected alternate route.

30 [0073] There may also be a load balancing control capable of determining when routing IP packets from primary channel are at maximum load, and then ensuring that

packets are routed over secondary channel for dynamic load control and to add bandwidth.

[0074] In a further embodiment of the system the core micro controller and IP switch and smart edge wireless hub controller includes a roaming secondary channel 5 dedicated to permanently un-numbered smart edge wireless hubs covering an entire metropolitan area network.

[0075] There may also be a secondary channel dedicated to permanently open connectivity for emergency use throughout a metropolitan area network providing a private channel for communicating and sending data in emergency conditions.

10 [0076] In one embodiment of the system two smart edge wireless hubs may operate as a master smart edge wireless hub configured as master controller and a slaved smart edge wireless hub configured as slaved to extend IP service between two locations.

[0077] There may also be a master edge wireless hub-A location configured as master controller and a slaved smart edge wireless hub-B location, each configured with 15 two antennas that communicate between each smart edge wireless hub A to B and to core microwave radio and micro controller, payload switch.

[0078] In one embodiment of the system the core micro controller and IP switch and smart edge wireless hub controller includes a licensed carrier microwave system with carrier current interface bridging wireless IP connectivity to home and office IP/electrical 20 interface component that transfers IP interface signals from smart edge wireless hub onto 110VAC or 220VAC commercial electric power lines and building wiring for use as data transmission over electrical lines. There may also be an IP to electrical adapter that transfers IP data packets over electrical lines carrying AC voltage. In such a system, the electric AC sockets deliver IP data through, and access for, an AC power connector that 25 is physically accessed for data plug and an AC to packet adapter that provides access to commercial AC power and IP Ethernet data plug whereby said data interface is isolated from AC voltage and where said data meets the QoS transmission standards specified for the network.

[0079] There may also be an AC to packet adapter whereby coupling of data and 30 AC distribution voltages are distributed over same conductor or conductors for purpose

of distributing both AC power and IP data through house and building wiring to sockets / plugs though out the premise.

[0080] A licensed multi-functional wireless broadband system with networking components and all user service access managed under central and distributed smart processing by the core system connecting with remote edge smart wireless hubs that radiates out and receives input of radio frequency signals directly in point to point and omni directional 60' to 360' degree networks. Arrays radiating multi-path RF signals of orthogonal frequency division, QPSK, and QAM type modulation providing efficient frequency reuse, and encoding algorithms for multi-transmission employing vertical/horizontal and orthogonal polarization polarity. The core system delivers a variety of one and two-way communication signals carrying multi services of private and public Wi-Fi signals and digital two-way transmission with internet content, IP video, data and voice [VoIP] packets. The system provides a user friendly on/off access in a patentable multi-user roaming, always on channel for access and emergency-public services through specifically dedicated bandwidth channels. A dynamic bandwidth controlled channel coupled with fixed and variable assigned bandwidth in the 27.5 to 29.5 GHZ millimeter wave band region is employed with very fast payload packet switching for routing over a series of available dynamic microwave channels managed through route sampling of automated quality of service (QoS) selection circuitry. The system has the ability to transmit, retransmit, receive, verify the highest of QoS, and dynamically select the best-improved RF path be it through orthogonal frequency division modulation, or QAM, QPSK modulation with adjustment of polarization, power control selection, and type encoding algorithm to meet predefined QoS requirements. Further dynamic route selections are achieved using fast packet management switching diversity coupled with route diversity, frequency diversity, encoding algorithm diversity and space diversity and radio frequency polarization diversity. The systems easy user-roaming channel is always available, ready to accept any prior-approved user for broadband services. Service is improved to a simplistic form, jump on at will and off at will that is controlled through a pre-registered access code centrally held in file, automatically addresses the user upon their first entry onto the network at any data grid point of network

[0081] This invention provides a new model for building and operating licensed radio networks, providing as it does for user ownership and operation of key network elements, as opposed to only subscriber terminal equipment. Equally important, the invention provides a new business and technical model for providing licensed voice and data services.

[0082] While the invention has been described with reference to the preferred embodiment thereof, it will be appreciated by those of ordinary skill in the art that various modifications and changes can be made to the structure and functions of the individual parts of the system without departing from the spirit and scope of the invention as a whole.

ABSTRACT

A microwave radio, multi-functional broadband system, using licensed RF spectrum that allows operation through and with multiple smart edge wireless hubs. The 5 system provides dynamic, automated selection of transmission types, including Quadrature Amplitude Modulation (QAM), Quadrature Phase Shift Keying (QPSK) and orthogonal frequency division multiplexing system for transmission and reception over point-to-point, point-to-multipoint and omni-directional antenna. The system also includes an intelligent packet measurement system that dynamically reads and controls 10 the network Quality of Service [QoS] through software. The automated control may include throttling power up and power down to meet changing effects of transmission parameters in substantially real time. The system can operate, at its simplest level, with a single smart edge hub, as a local network or, through application of additional elements, as a wide area network, or as a combination of local area and wide area network within 15 an integrated system.

FIG. 1

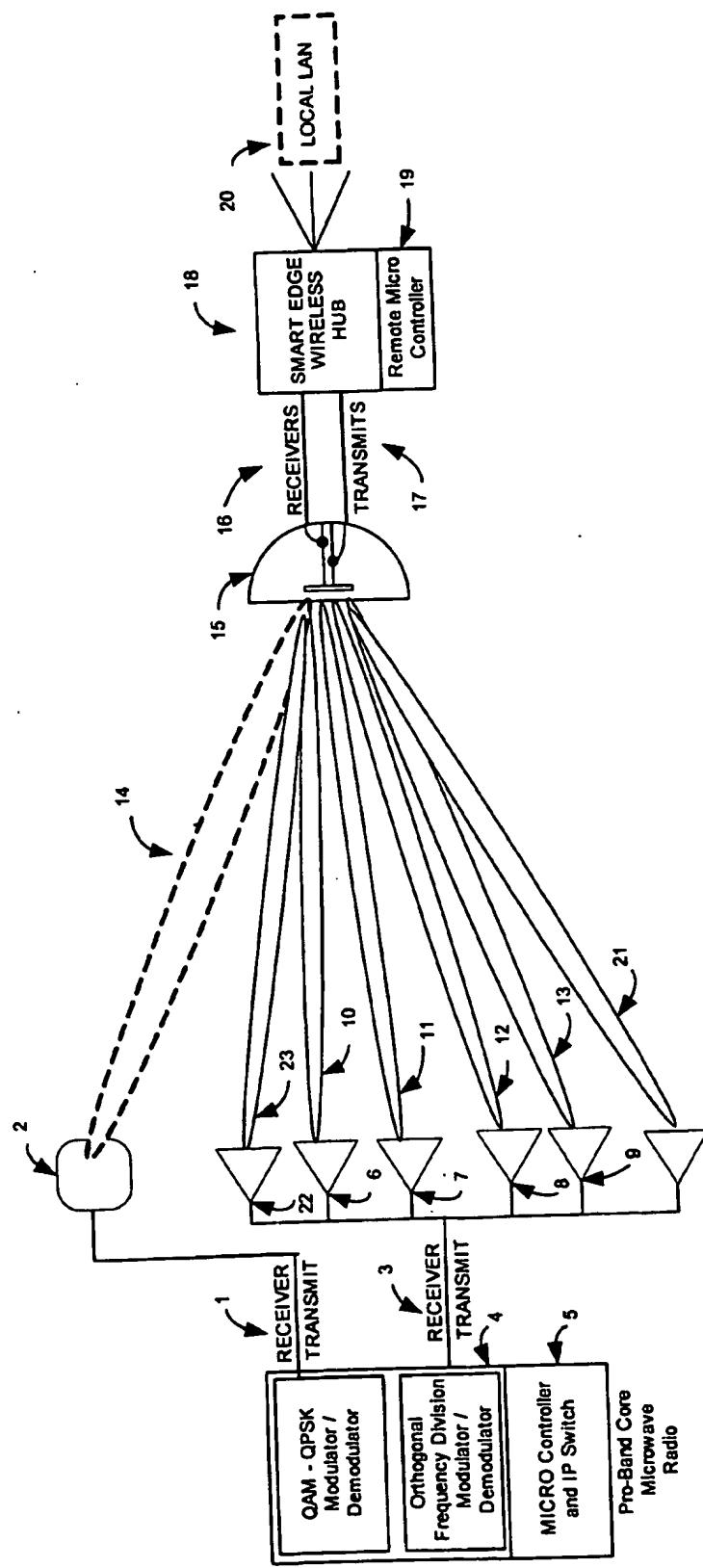


FIG. 2

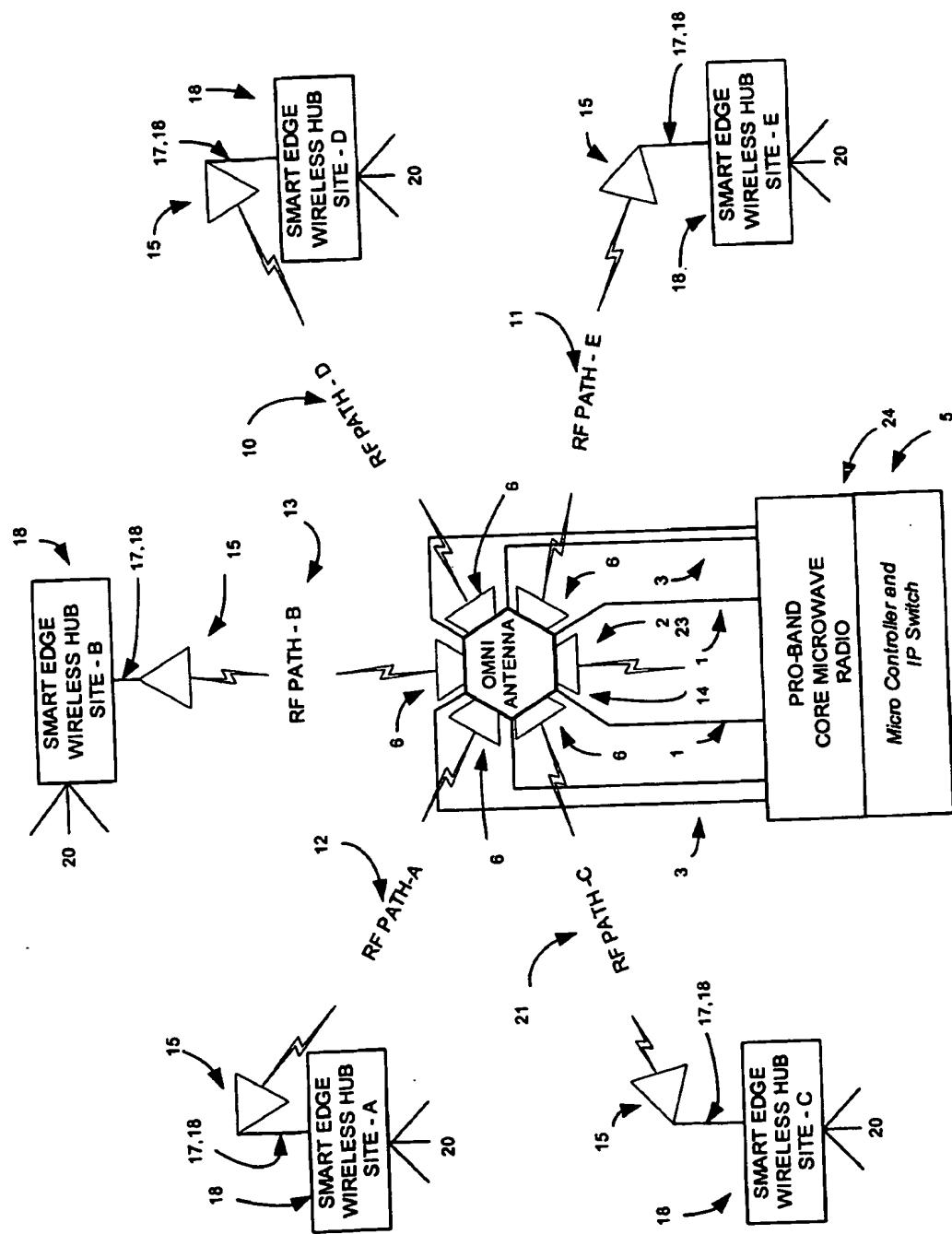


FIG. 3.

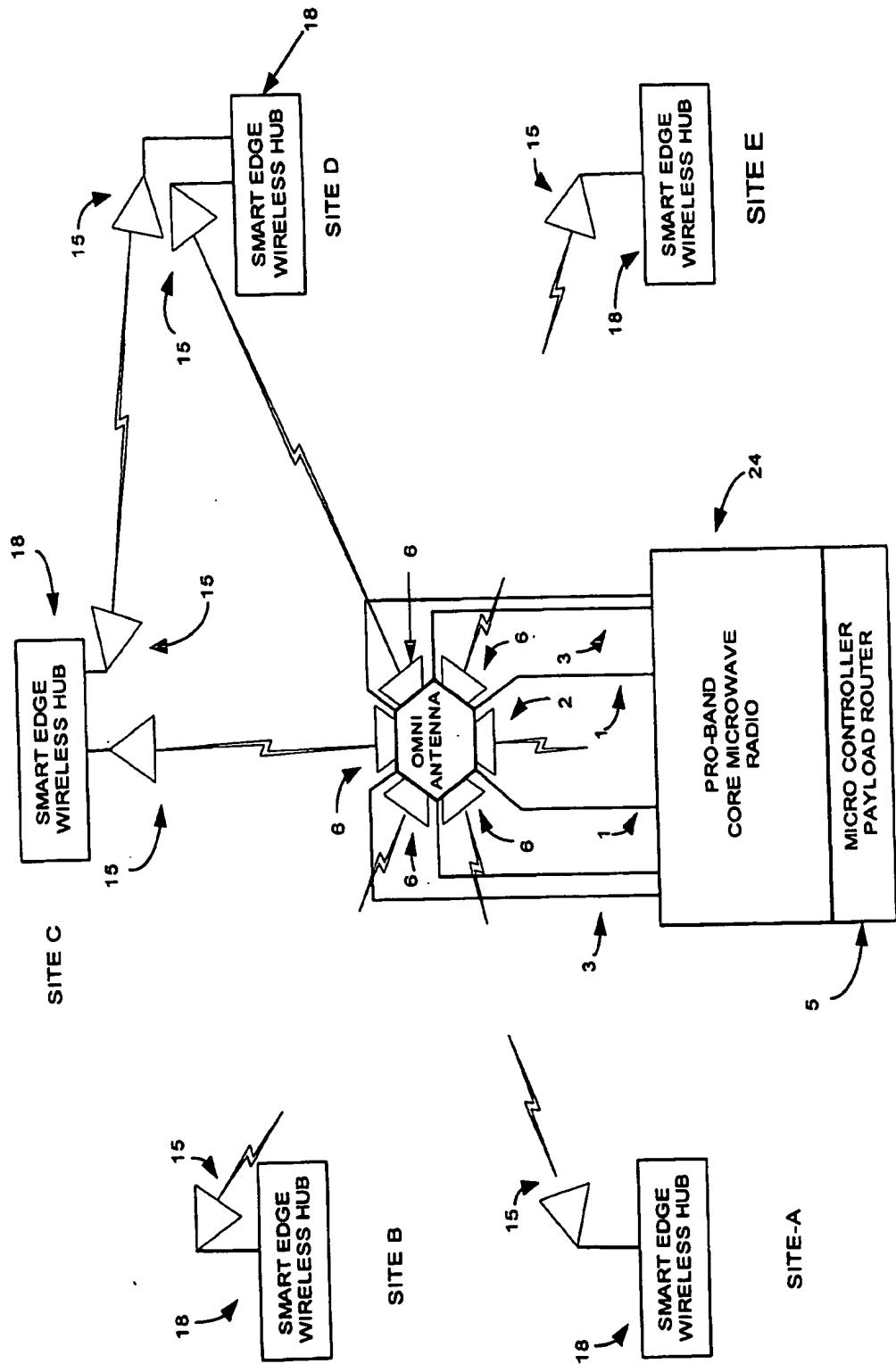


FIG. 4

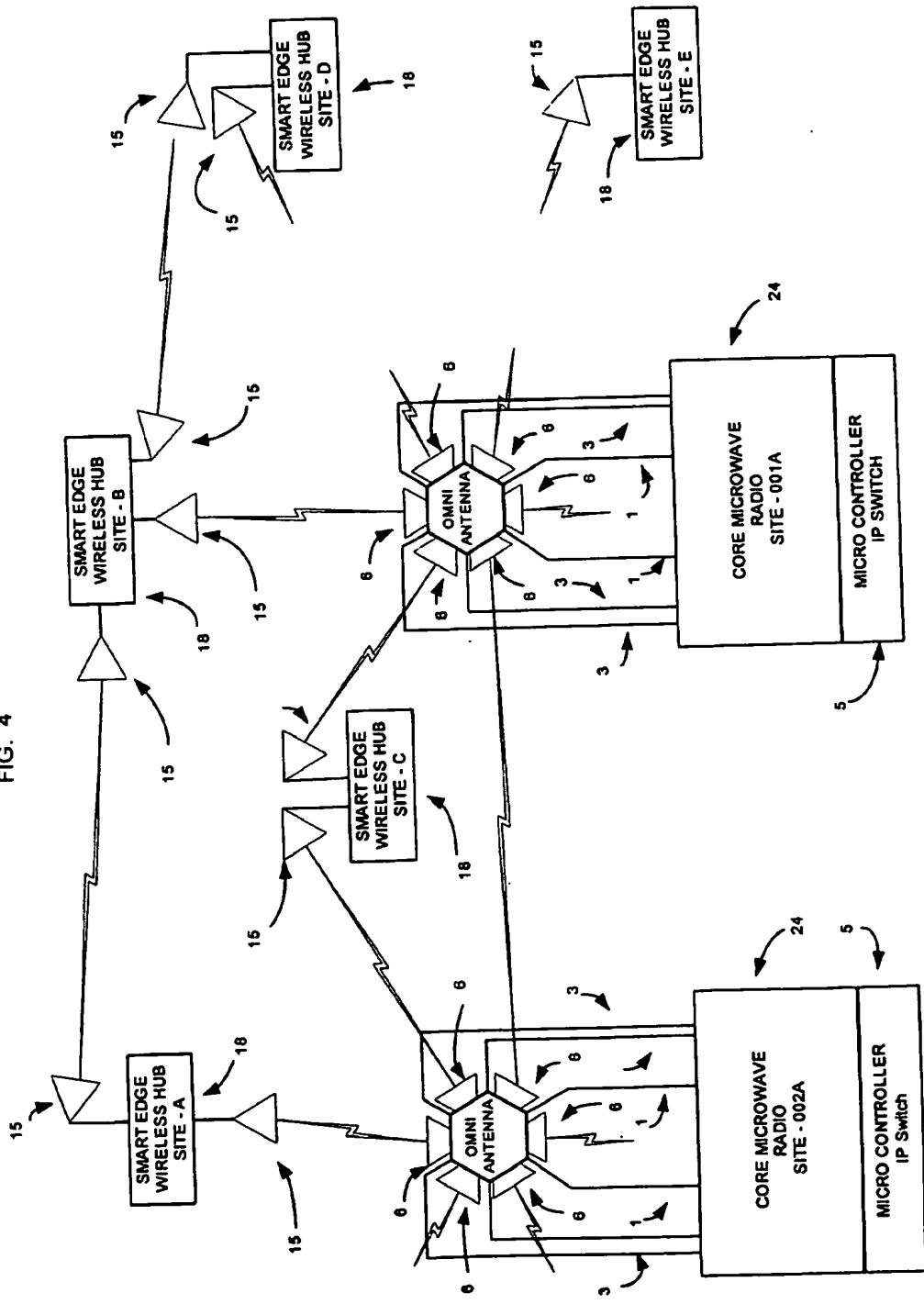


FIG.5

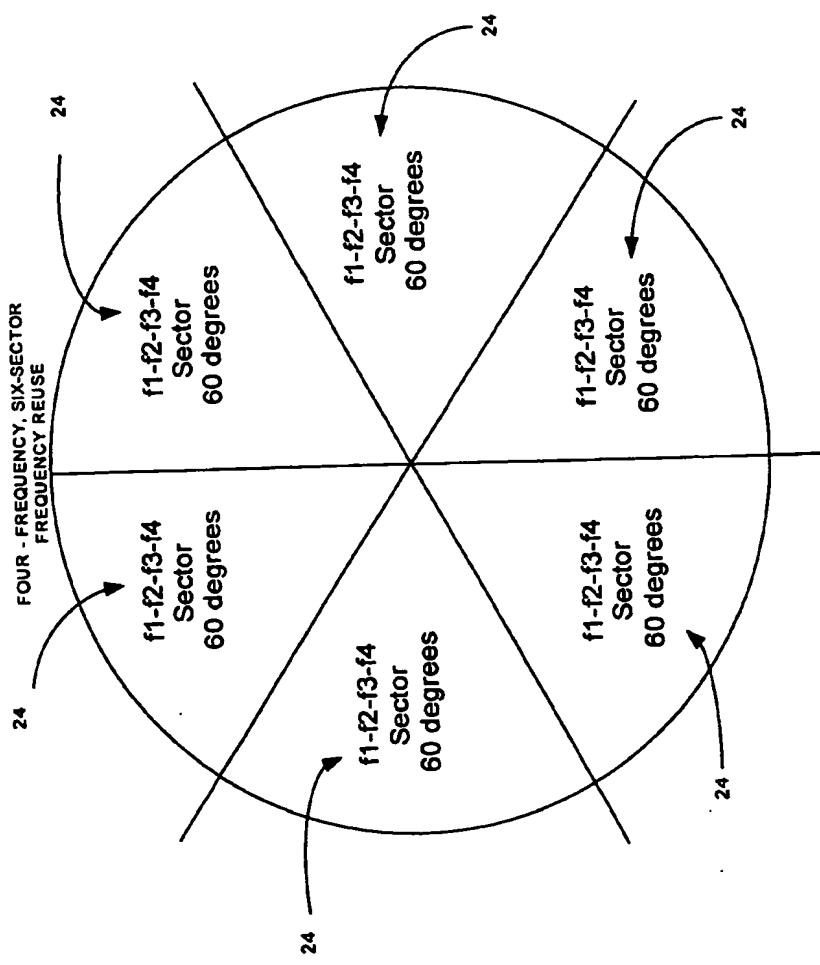


FIG. 6

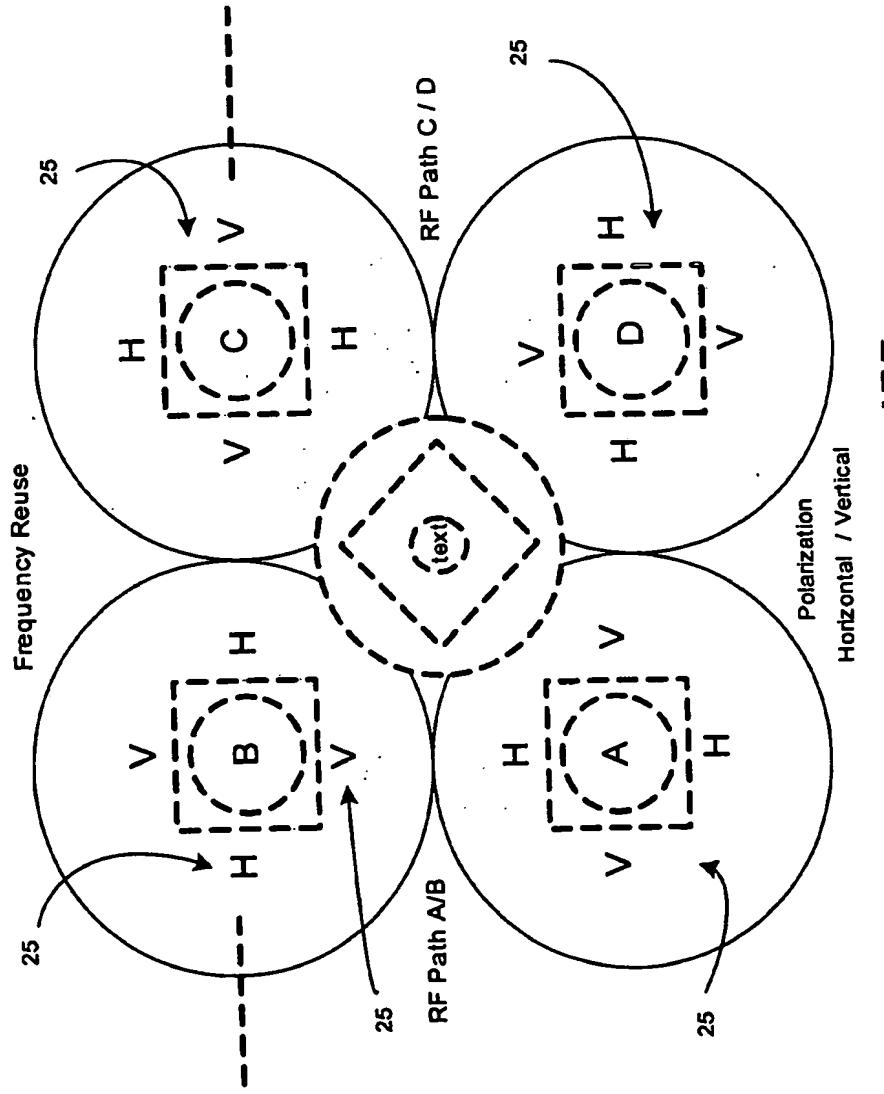


FIG. 7

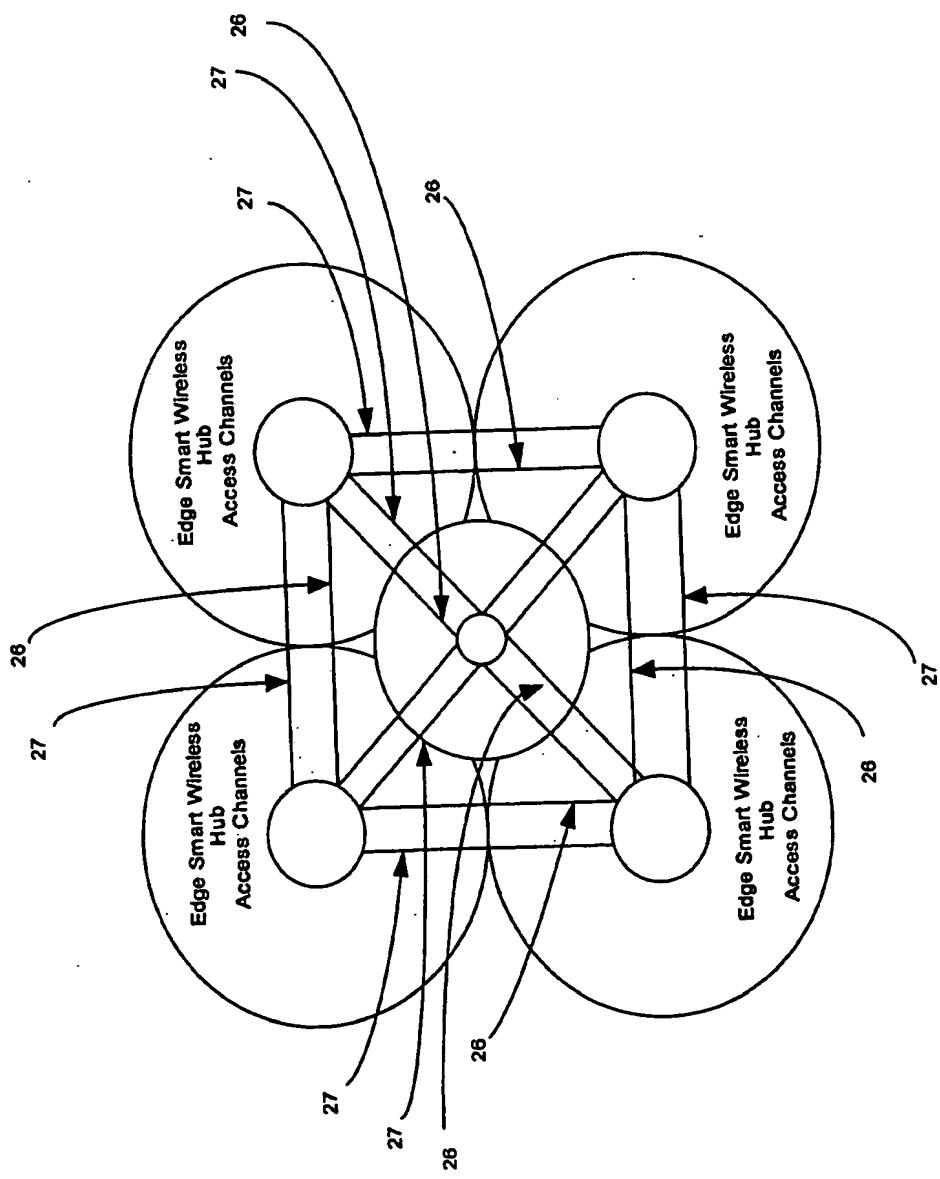


FIG. 8

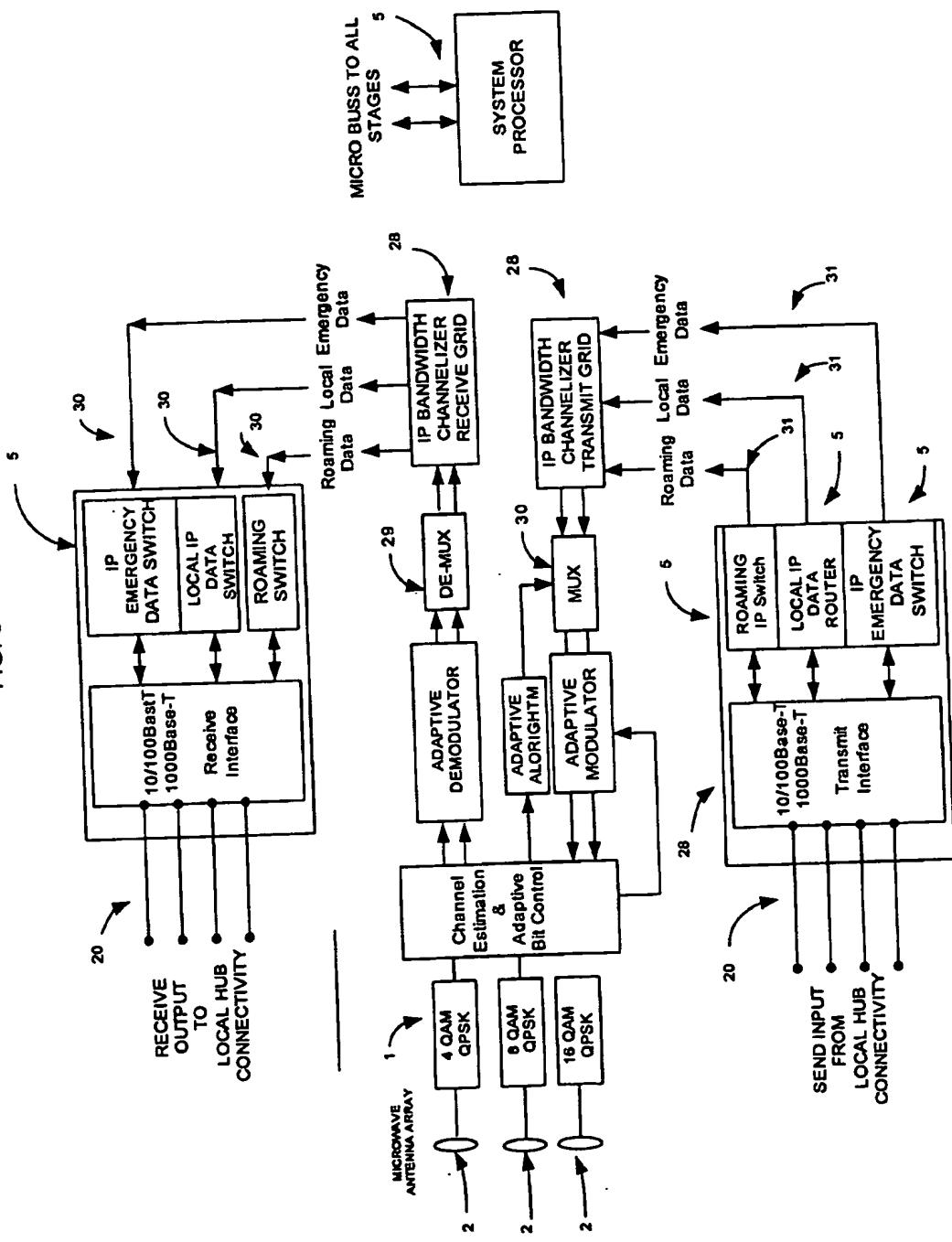
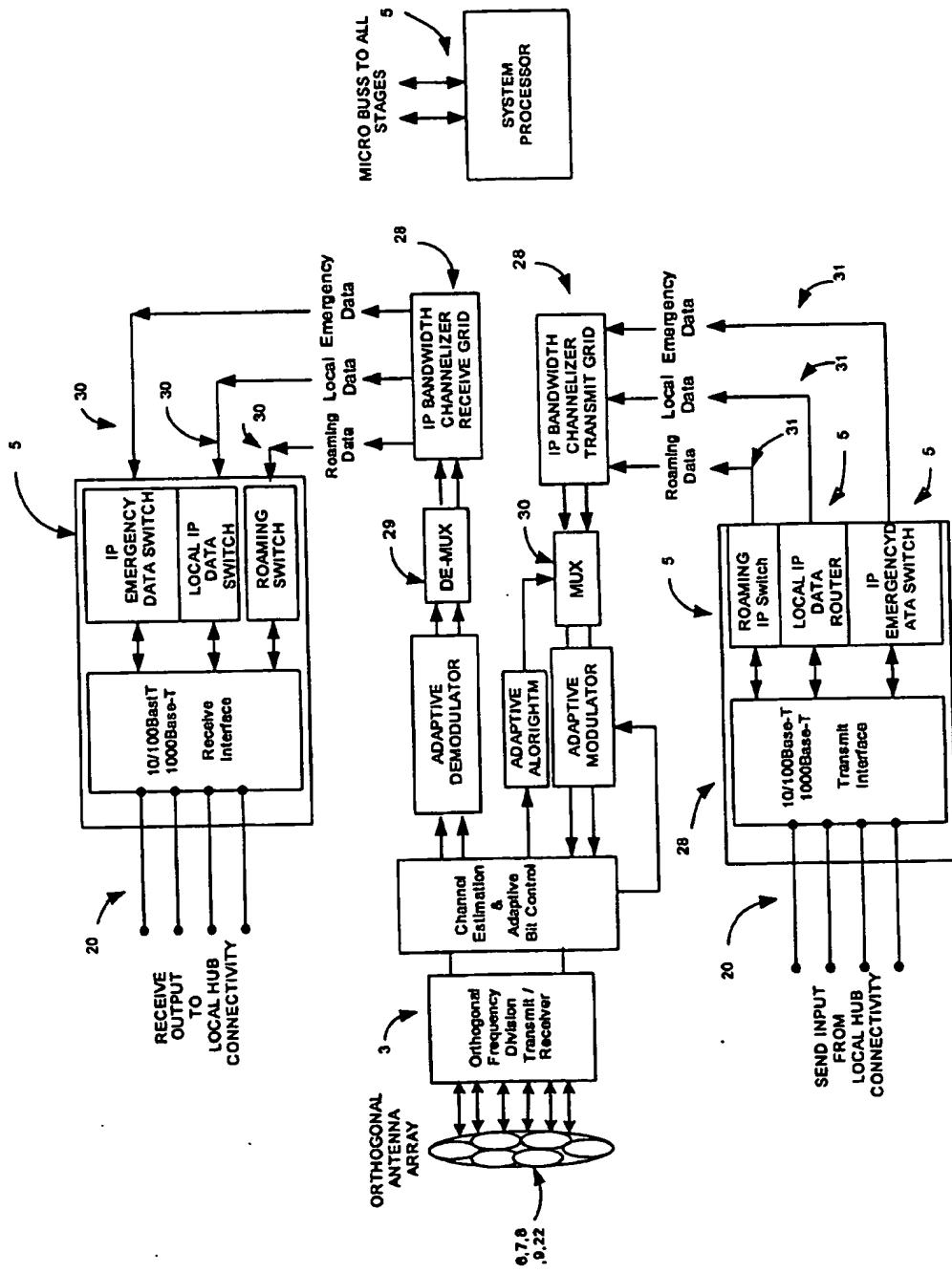


FIG. 9



Drawings for Provisional application 5261-105P
Sheet 10 of 10

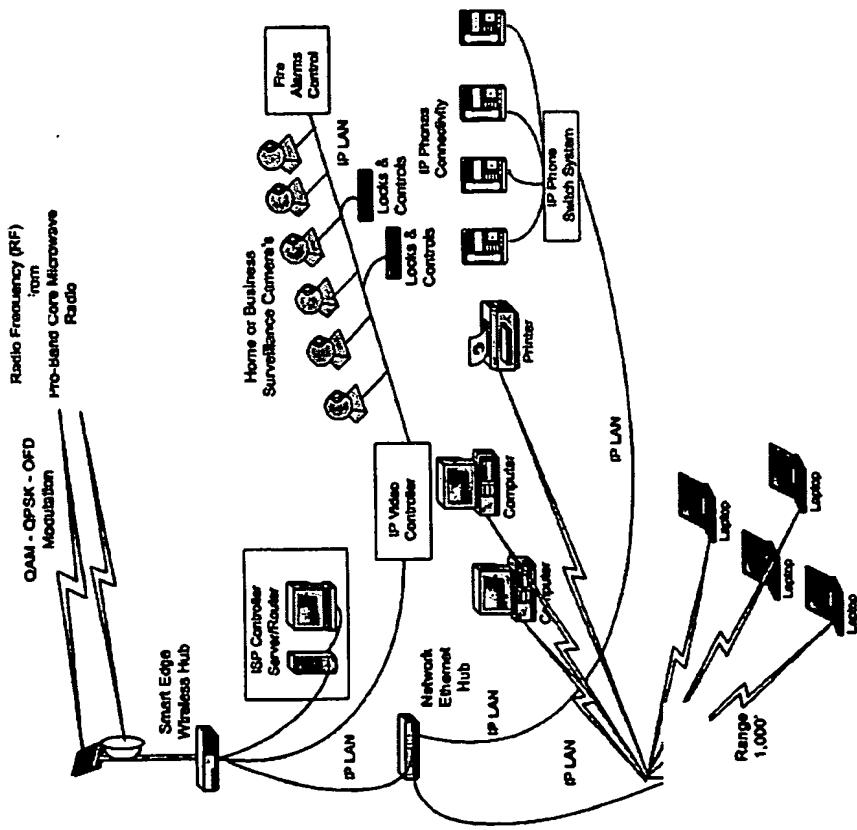


FIG. 10

-VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (c)) - SMALL BUSINESS CONCERN				Docket No. 5261-105P
Serial No. HEREWITH	Filing Date HEREWITH	Patent No.	Issue Date	
<p>Applicant/ Marvin Ward; Chris Vizas and Shant Hovnanian Patentee:</p> <p>Invention: WIRELESS BROADBAND LICENSED NETWORKING SYSTEM FOR LOCAL AND WIDE AREA NETWORKING</p>				
<p>I hereby declare that I am:</p> <p><input type="checkbox"/> the owner of the small business concern identified below: <input checked="" type="checkbox"/> an official of the small business concern empowered to act on behalf of the concern identified below:</p>				
<p>NAME OF CONCERN: <u>Speedus Corp.</u></p> <p>ADDRESS OF CONCERN: <u>140 58th Street, Loft 7E, Brooklyn, NY 11220</u></p>				
<p>I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.</p>				
<p>I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the above identified invention described in:</p> <p><input checked="" type="checkbox"/> the specification filed herewith with title as listed above. <input type="checkbox"/> the application identified above. <input type="checkbox"/> the patent identified above.</p>				
<p>If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed on the next page and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).</p>				

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WoodbridgeAssociates 2003

Page 2 of 2

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING:

Shant Movnasan

TITLE OF PERSON SIGNING

OTHER THAN OWNER:

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SIGNATURE:

DATE:

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